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Using drone imagery and group field activities for an in-depth investigation of the vascular flora: a case study in the Rocca di Novara Massif (NE Sicily, Italy)

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Abstract

Rocky habitats are suitable refuges for numerous rare and endemic plants. Due to their inaccessibility and the unreliability of traditional survey methods, assessing the survival status of these plants is quite a hard task. In order to address this sampling issue, we employed the drones and carried several field activities to investigate the vascular flora of Rocca di Novara massif located in Northeastern Sicily (NE Sicily hereafter). Located on the southern border of the Peloritani Mountains, Rocca di Novara, also known as Rocca Salvatesta, is a small carbonate massif and it represents one of the highest and most characteristic peaks in NE Sicily. According to our investigation, 300 taxa have been recorded, belonging to 189 genera and 51 different families. The results obtained show the presence of 13 endemic species to Italy (4.3%) and 12 strictly endemic to Sicily (4%). Some taxa of high phytogeographical value have been detected, such as *Aubrieta columnae* subsp. *sicula*, *Daphne oleoides* subsp. *oleoides*, *Edraianthus graminifolius* subsp. *siculus*, *Fritillaria messanensis*, *Odontites bocconei* subsp. *bocconei*, *Phelipanche gussoneana*, *Saxifraga callosa* subsp. *australis*. This latest species was rediscovered after 100 years on the high cliffs of Rocca di Novara thanks to the use of the drone imagery. Our results provide valuable insights into the floristic diversity of Rocca di Novara and offers a solid starting point for further phytogeographical and floristic studies on the vascular plants of the Peloritani district.

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Keywords
Conservation, cliffs, drone imagery, endemic plants, Peloritani district, rare plants, red list

Introduction

This paper aims to assess the vascular plant diversity of Rocca di Novara, one of the highest and most characteristic peaks of the Peloritani Mountains (NE Sicily). The study stems from a field activity organized by the Italian Botanical Society as part of an "Intensive course in the determination of vascular plants", held on May 21, 2022. The choice to carry out a floristic survey in Rocca di Novara was prompted by limited availability of floristic literature and at the same time the presence of a rupicolous vascular flora of a significant phytogeographic interest. The Peloritani mountain range stretches for about 70 km along the north-eastern portion of the island, and is characterized by numerous reliefs with peaks that slightly exceed 1,300 m a.s.l. The morphology of the mountain range is characterized by a series of peaks, ridges, screes that go downstream into deep gorges with countless watercourses which eventually open into braided streams, often filled with debris and torrential flows (Blasi 2010; Goswami et al. 2011; Sciandrello et al. 2015). Geologically, this territory is characterized by the prevalence of crystalline and intrusive metamorphic rocks (gneisses, schists, mycaschists), issuing from different stratigraphic units and give rise to a variable and tormented morphology. In the territory sedimentary rocks such as limestones, quartz sandstones and, sandy deposits crop out in this territory, too (Appel et al. 2011; Fiannacca et al. 2013). The harsh topography of Rocca di Novara, chacterised by steep slopes, scree and the rocky cliffs acts as a physical barrier to most anthropogenic interventions; as strongly reduce accessibility also to botanists, contributing to preserve the rarest and most threatened plant species. Indeed, the floristic investigation of such inaccessible habitats has been possible thanks to drone technology. Most frequenty, we let drones flying vertically along the cliff faces while taking intermittent photographic samples for species identification (Zhou et al. 2021). This method can be used to identify most vascular plants on the cliffs and to analyze plant diversity (Zhou 2022; Zhu 2022; Kim et al. 2023; Gao et al. 2024; Tavilla et al. 2024).

From a floristic point of view, this area is characterized by a significant number of species belonging mainly to European, Eurasian and Circumboreal elements, which probably arrived during the glaciations. Furthermore, the presence of around 15 species strictly endemic to the Peloritani Mountains deserves to be mentioned, as well as the occurrence of a rather high amount of species in common with Calabria but missing in the rest of the island (Brullo et al. 1995; Sciandrello et al. 2015). Previously, Rocca di Novara has rarely been specifically investigated, except for a very short list of taxa occurring in this area published by Nicotra (1880) and Picone et al. (2000). Other sporadic data are reported by Gussone (1843), Borzì (1887), Nicotra and Campagna (1908), and Giardina (1995). This paper provides updated data on its flora and analyzes some endemic and threatened species, to enhance their conservation and management.

Materials and methods

Data collection and analysis

Field activities have been carried out in May 2022, as well as in May, June and November 2023 with the aim of deepening the research and gaining a more complete understanding of the species of seasonal flora. Observations we conducted across different seasons to capture the varied botanical landscape. Some plant specimens were collected in the field and subsequently dried and deposited at the Herbarium of the University of Catania (CAT) and in the Herbarium Mediterraneum Panormitanum (PAL). The identification of the species was mainly made by using the recent flora of Italy (Pignatti et al. 2017–2019). The nomenclature used follows mainly Bartolucci et al. (2024). Drone surveys were carried out in May and June 2022 in order to reach inaccessible rock cliffs. All drone flights were conducted using a DJI Mavic Mini.

Study area

Rocca di Novara (37°59'41.42"N, 15°08'48.21"E), also called "Rocca Salvatesta" or popularly "Cervino di Sicilia", due to its characteristic truncated-conical shape, reaches an altitude of 1340 m a.s.l. (Fig. 1). The relief is located on the southern border of the Peloritani Mountains, in the territories of Novara di Sicilia and Fondachelli Fantina. From the geological point of view, the Rocca di Novara Unity is constituted by limestone formation of Mesozoic origin overlapping on a siliceous basement (Atzori et al. 1979; Lentini and Carbone 2014). The woody vegetation is mainly represented by

Figure 1. Map of surveyed area with the boundaries of the ZSC "Rocca di Novara" (ITA030006).

scattered nuclei of holm oak woods, where *Quercus ilex* L. is associated with isolated individuals of hop-hornbeam (*Ostrya carpinifolia* Scop.). However, the original forest vegetation is almost completely replaced by aspects of shrubby vegetation referable to the class *Rhamno catharticae-Prunetea spinosae* Rivas Goday & Borja ex Tüxen 1962 or, more frequently, by aspects that are highly degraded due to grazing and frequent fires, dominated by *Pteridium aquilinum* (L.) Kuhn subsp. *aquilinum* (*Pteridio-Tanacetetum siculi* Brullo & Marcenò, 1985), belonging to the class *Artemisietea vulgaris* Lohmeyer, Preising & Tüxen ex Von Rochow 1951. However, the ancient presence of mesophilous woods is demonstrated by the persistence of some nemoral species that find a refuge habitat near the shady cliffs or even in the shady areas under the tufts of *Pteridium aquilinum* subsp. *aquilinum*. Among these species, *Symphytum gussonei* F.W.Schultz, *Melittis melissophyllum* subsp. *albida* (Guss.) P.W.Ball (Fig. 2F), *Stachys sylvatica* L. (Fig. 2B), *Galanthus regina-olgae* subsp. *vernalis* Kamari and *Fritillaria messanensis* Raf. subsp. *messanensis* (Fig. 2G) deserve to be mentioned. The carbonate cliffs (Fig. 3A) host a very peculiar casmophilous vegetation with some species that have their only station here on the Peloritani mountains, such *Saxifraga callosa* subsp. *australis* (Moric.) Pignatti ex Tavilla & Del Guacchio, *Daphne oleoides* Schreb. subsp. *oleoides* and *Aubrieta columnae* subsp. *sicula* (Strobl) M.A.Koch, D.A.German & R.Karl. This orophilous vegetation may be referred to the class *Asplenietea trichomanis* (Br.-Bl. in Meier & Br.-Bl. 1934) Oberdorfer 1977. Overall, the current vegetation shows a high degree of degradation. This is due to several anthropogenic disturbance factors such as intensive grazing, frequent fires and other activities as excursions and religious pilgrimages to reach the cross at the top..

Currently, the entire surveyed area is part of the Sicilian Natura 2000 network and belongs to the SAC ITA030006 "Rocca di Novara" .

Results

A total of 300 plant taxa have been recorded, belonging to 190 genera and 51 families (Appendix 1). The pteridophytes account for 10 taxa, i.e. *Asplenium ceterach* L. subsp. *ceterach*, *A. trichomanes* L. subsp. *trichomanes*, *A. onopteris* L. (Aspleniaceae), *Polypodium cambricum* L. (Polypodiaceae), *Anogramma leptophylla* (L.) Link, *Adiantum capillus-veneris* L. (Pteridaceae), *Pteridium aquilinum* subsp. *aquilinum* (Dennstaedtiaceae), *Dryopteris pallida* subsp. *pallida* (Bory) Maire & Petitm. subsp. *pallida*, *Polystichum setiferum* (Forssk.) T.Moore ex Woyn. (Dryopteridaceae) and *Selaginella denticulata* (L.) Spring. However, Angiospermae is by far the most represented taxonomic group. In particular, 53 taxa belonging to 10 families are monocots (17.75%), while the remaining 247 taxa are eudicots (82.35%).

Nine families include more than 10 taxa each, Asteraceae with 37 taxa (12.3%), Fabaceae with 30 (10%), Lamiaceae with 24 (8%), Poaceae with 21 (7%), Caryophyllaceae with 18 (6%), Brassicaceae with 16 (5.3%), Orchidaceae with 14 (4.7%), Apiaceae with 11 (3.7%) and Plantaginaceae with 10 taxa (3.3%) (Fig. 4). The relatively

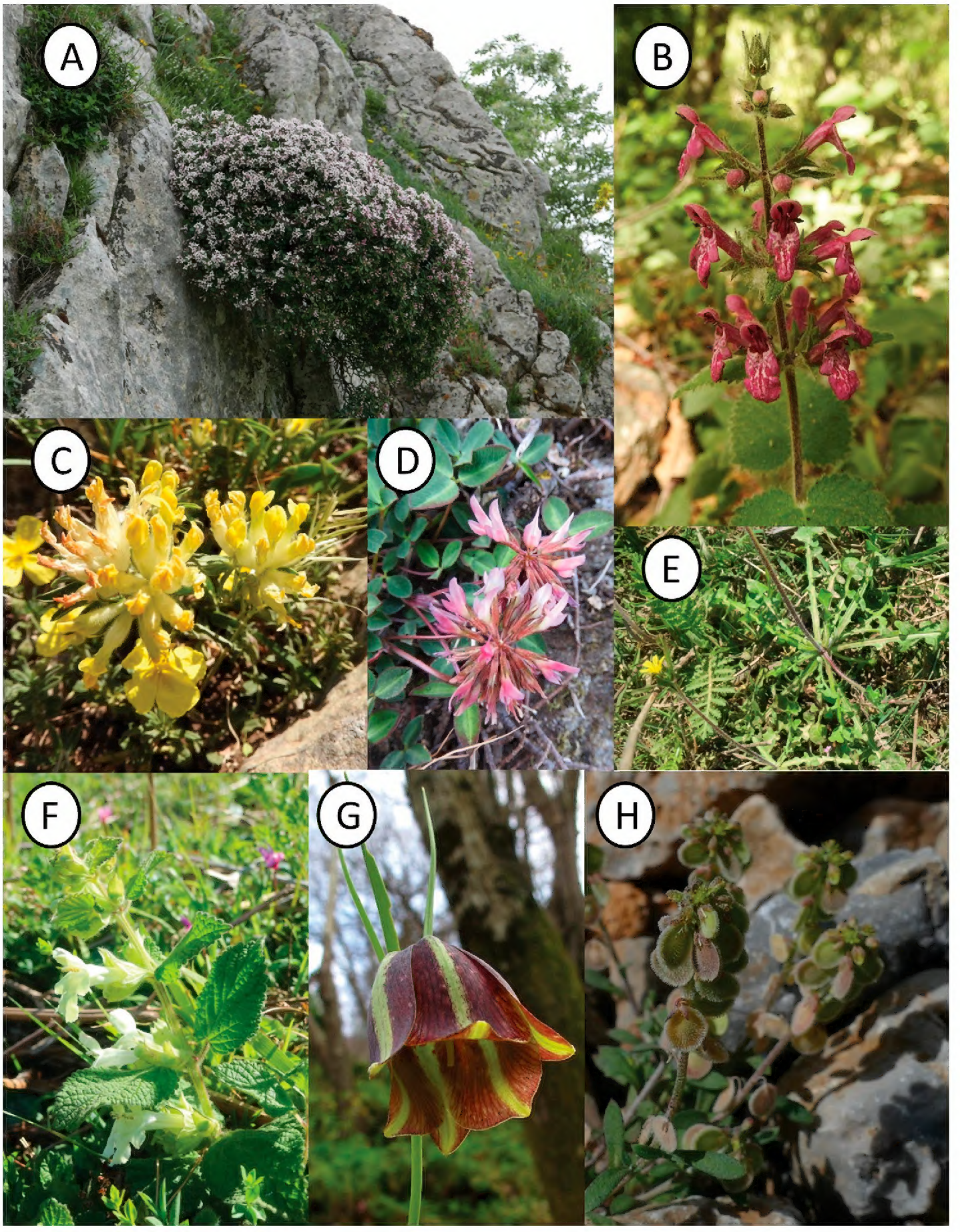

Figure 2. *Daphne oleoides* subsp. *oleoides* (**A**) *Stachys sylvatica* (**B**) *Anthyllis albiflora* (**C**) *Trifolium bivonae* (**D**) *Crepis sancta* (**E**) *Melittis melissophyllum* subsp. *albida* (**F**) *Fritillaria messanensis* subsp. *messanensis* (**G**) *Clypeola jonthlaspi* (**H**).

low number of Poaceae may be related to the lack of habitats with greater diversity of grasses, as prevailing vegetation types, such as communities with *Pteridium aquilinum* or subvertical cliffs are dominated by other families.

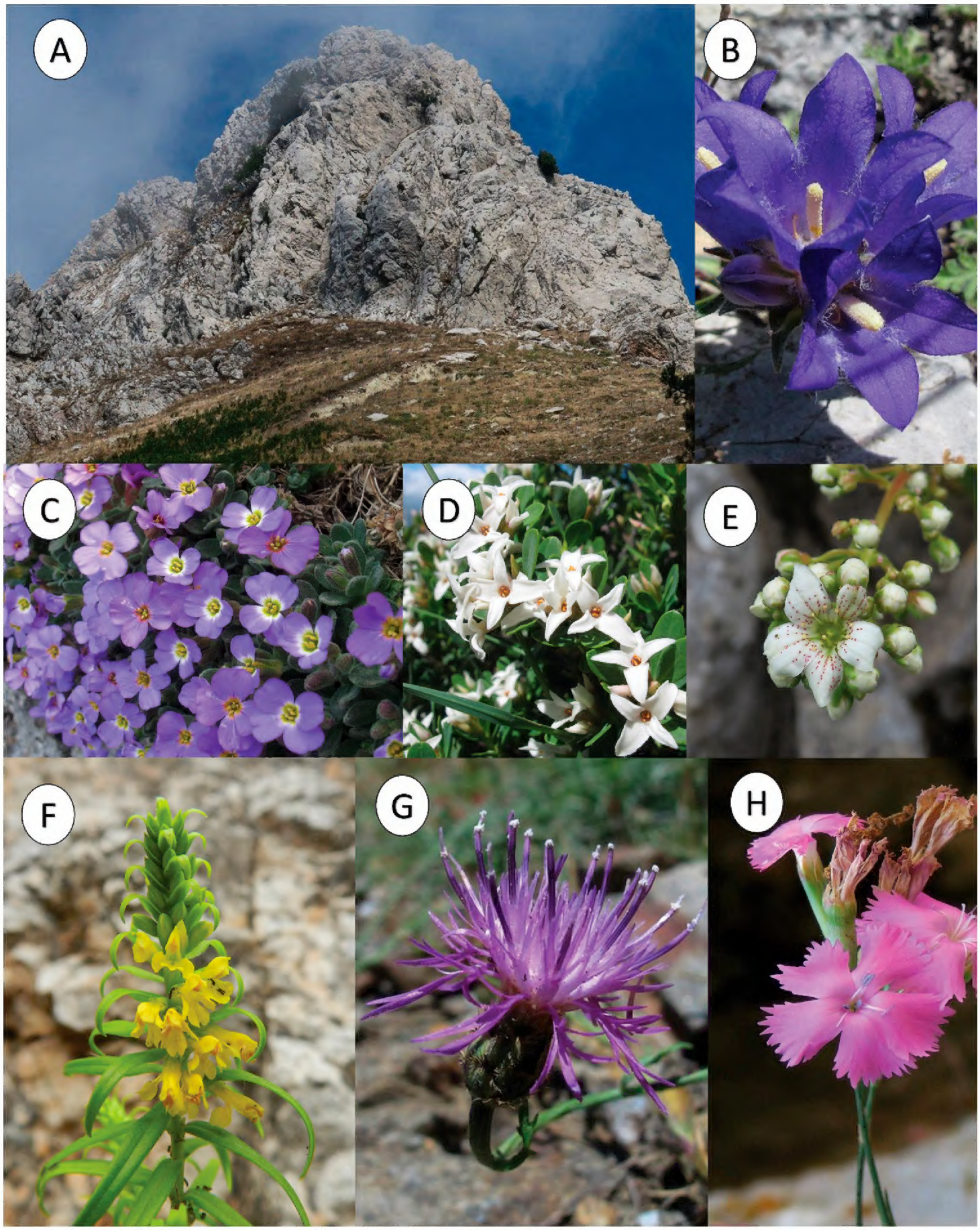

Figure 3. Panoramic view of the top of Rocca di Novara (**A**) *Edraianthus graminifolius* subsp. *siculus* (**B**) *Aubrieta columnae* subsp. *sicula* (**C**) *Daphne oleoides* subsp. *oleoides* (**D**) *Saxifraga callosa* subsp. *australis* (**E**) *Odontites bocconei* subsp. *bocconei* (**F**) *Centaurea gussonei* (**G**) *Dianthus graminifolius* (**H**).

The most abundant genus is *Trifolium* L. with 14 different taxa, followed by *Medicago* L. with 7, *Geranium* L. with 6, *Crepis* L., *Plantago* L., *Saxifraga* Tourn. ex L. and *Silene L.*each with 5 (Fig. 5).

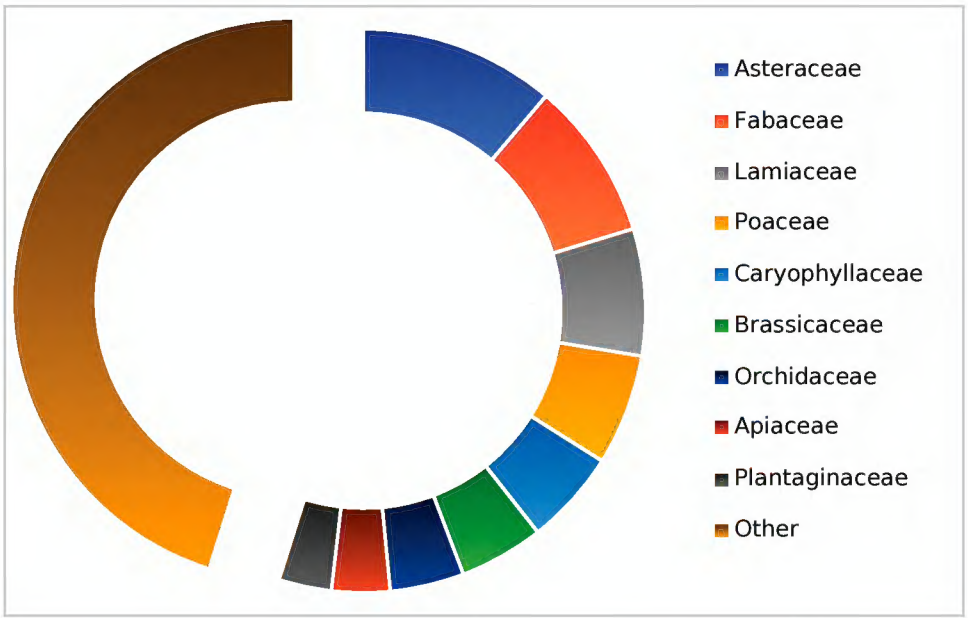

Figure 4. Areogram of the dominant families in the Rocca di Novara site (ME).

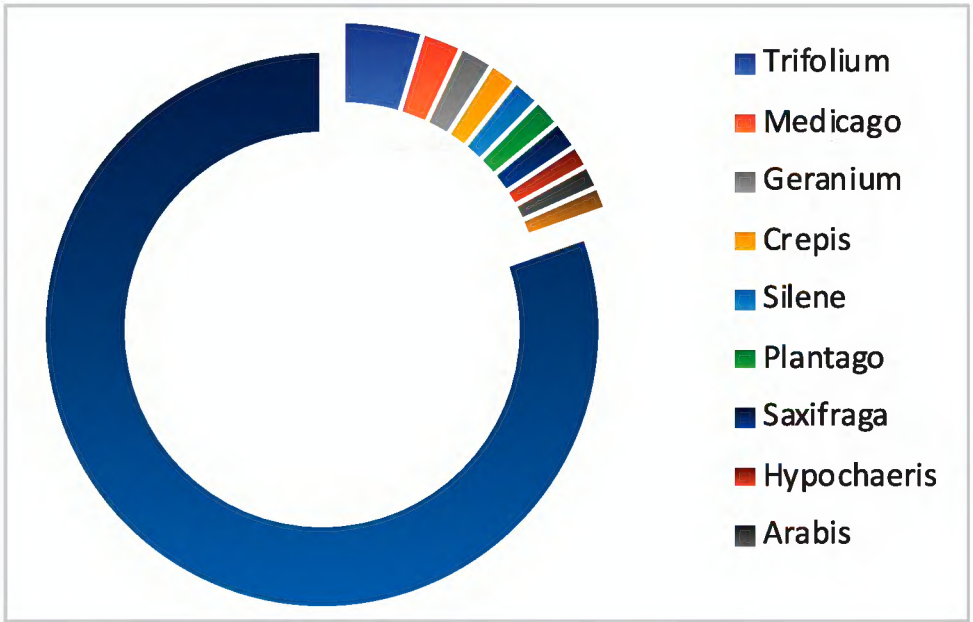

Figure 5. Distribution of predominant genera at Rocca di Novara (ME) site.

Regarding the geographic origin of the species and the infraspecific taxa, 24.7% are stenomediterranean, 21.7% eurimediterranean, 4.7% are cosmopolitan, 4.3% Italian endemics, 4% for Sicilian endemics and Eurasian, 3.7% belong to desert and subdesert areas from the Mediterranean to Central Asia (Mediterranean-Touranian) (Fig. 6).

As regards the endemic flora, it includes 12 taxa exclusive of Sicily and further 13 endemics shared with other regions of Italy.

Specifically, the Sicilian endemic taxa are *Anthyllis albiflora* (Guss.) Iamonico, Domina, Guarino & Del Guacchio (Fig. 2C), *Aubrieta columnae* subsp. *sicula*, *Centaurea gussonei* Raimondo & Spadaro, *Dianthus graminifolius* C.Presl, *Echium italicum* subsp. *siculum* (Lacaita) Greuter & Burdet, *Leontodon siculus* (Guss.) Nyman, *Odontites bocconei* (Guss.) Walp. subsp. *bocconei*, *Ophrys subfusca* subsp. *archimedea* (P.Delforge & M.Walravens) Kreutz, *O. fusca* subsp. *obaesa* (Lojac.) E.G.Camus & A.Camus, *Symphytum gussonei* F.W.Schultz, *Tanacetum vulgare* subsp. *siculum* (Guss.) Raimondo & Spadaro and *Trifolium bivonae* Guss. (Fig. 2D). Most of these species

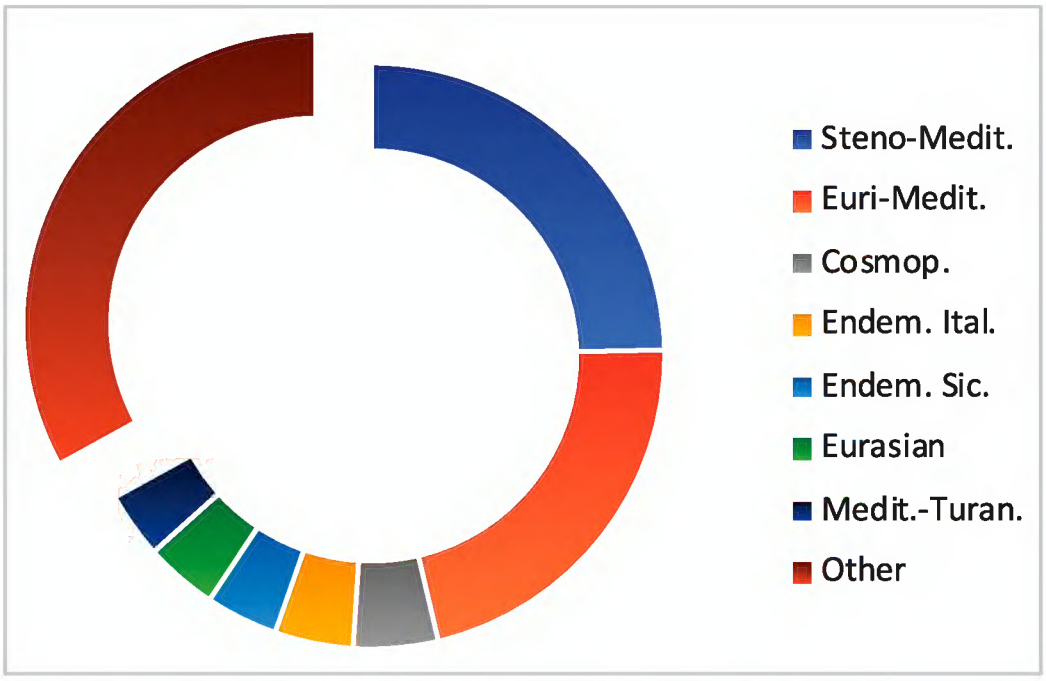

Figure 6. Proportion of major chorotype categories in the flora of Rocca di Novara (ME).

show a wide distribution across the northern mountains of Sicily, while *Centaurea gussonei*, a taxon belonging to *Centaurea parlatoris* Heldr. species complex (Domina et al. 2021), has a narrower distribution in the North-Eastern part of Sicily. Conversely, *Anthyllis albiflora* and *Dianthus graminifolius* show a distribution centered in the westerm part of the island. Regarding the latter, a taxon linked to thermophilous grasslands (Bacchetta et al. 2010), the population of Rocca di Novara is unusually linked to more orophilous cliffs stands and shows some transitional characters towards *D. busambrae* Soldano & F.Conti, deserving further taxonomic studies.

On the other hand, as far as Italian endemics are concerned, the following have been recorded: *Anthemis arvensis* subsp. *sphacelata* (C.Presl) R.Fern., *Arabis collina* subsp. *rosea* (DC.) Minuto, *Aristolochia clusii* Lojac., *Bellis margaritifolia* Huter, Porta & Rigo, *Carlina hispanica* subsp. *globosa* (Arcang.) Meusel & Kästner, *Edraianthus graminifolius* subsp. *siculus* (Strobl) Lakušić ex Greuter & Burdet, *Galium pallidum* C.Presl, *Linaria multicaulis* (L.) Mill. subsp. *multicaulis*, *Myosotis sylvatica* subsp. *elongata* (Strobl) Grau, *Orchis brancifortii* Biv., *Ranunculus pratensis* C.Presl, *Silene italica* subsp. *sicula* (Ucria) Jeanm. and *Viola aethnensis* subsp. *messanensis* (W.Becker) Merxm. & Lippert.

Besides, some rare or very rare species at a regional level, as reported in Giardina et al. (2007), have been detected, such as *Daphne oleoides* subsp. *oleoides*, *Saxifraga callosa* subsp. *australis*, *Clypeola jonthlaspi* L. (Fig. 2H), *Crepis neglecta* L. subsp. *neglecta*, *C. sancta* (L.) Bornm. subsp. *sancta* (Fig. 2E), *Tuberaria inconspicua* (Pers.) Willk., *Lomelosia crenata* (Cirillo) Greuter & Burdet subsp. *crenata*, *Melittis melissophyllum* subsp. *albida* (Guss.) P.W.Ball, *Phelipanche gussoneana* (Lojac.) Domina, Raab-Straube, Rätzel & Uhlich, and *Fritillaria messanensis* subsp. *messanensis*.From the total number of taxa, 39.3% were annual or biennial plants (therophytes), while 60.7% were perennial species. Among the perennial species, the most abundant life forms were hemicryptophytes (32.7%), geophyte (13%) and chamaephytes (10.7%). Phanerophytes and nanophanerophytes were rather few (3.7% and 0.7%, respectively) (Fig. 7).

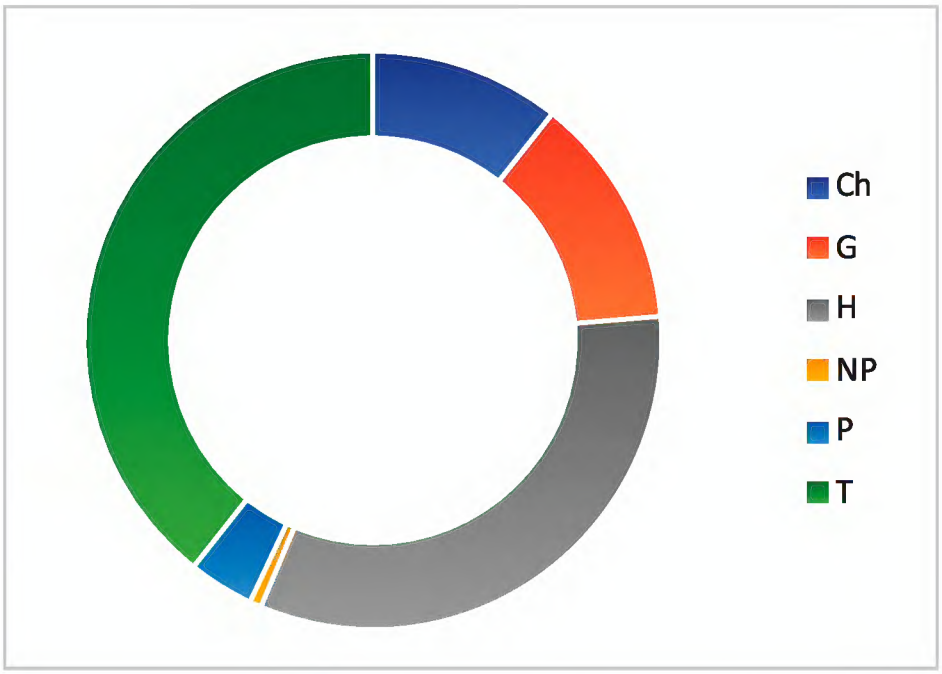

Figure 7. Breakdown of life form spectra for plant species at Rocca di Novara (ME) location.

A total of 36 taxa (12%) were found to be included in the IUCN risk categories. Among the recorded species *Aubrieta columnae* subsp. *sicula*, *Fritillaria messanensis* subsp. *messanensis*, *Linaria multicaulis* subsp. *multicaulis* are endangered, *Centaurea gussonei* and *Dianthus graminifolius* are vulnerable, *Biscutella maritima* Ten., *Neotinea lactea* (Poir.) R.M.Bateman, Pridgeon & M.W.Chase, *Plantago cupanii* Guss., *Symphytum gussonei* F.W.Schultz and *Trifolium bivonae* Guss. are classified as Near Threatened. Another 26 species are Least Concern (Orsenigo et al. 2020; Rossi et al. 2020). Some remarks regarding the presence of the taxa of greatest phytogeographical interest in the surveyed area are reported below.

Aubrieta columnae* subsp. *sicula (Strobl) M.A.Koch, D.A.German & R.Karl (Fig. 3C): this taxon shows a disjunct distribution, being represented only in the peaks of Madonie massif (W Sicily) and in the isolated stand of Rocca di Novara (Giardina et al. 2007). It is linked to mountain cliffs.

Crepis sancta (L.) Bornm.: the occurrence of this taxon in Sicily was reported for the first time by Gramuglio et al. (1959), but this report was later considered doubtful by Giardina et al. (2007) and consequently its presence in Sicily was considered uncertain in subsequent checklists of the Italian flora. Our finding confirms the presence of this species in Sicily.

Daphne oleoides* Schreb. subsp. *oleoides (Figs 2A, 3D): it is an orophilous taxon very rare in Sicily, where it is known only for the Madonie mountain and Rocca di Novara (Giardina et al. 2007). This species is linked to limestone cliffs, but sometimes it is also present on rocky slopes and screes.

***Edraianthus graminifolius* (L.) A.DC. ex Meisn. subsp. *siculus* (Strobl) Lakušić ex Greuter & Burdet** (Fig. 3B): this taxon is endemic of Southern Italy and Sicily, growing in rocky slopes and cliffs of mountain stands. In Sicily it occurs only in the Madonie massif, Rocca Busambra and Peloritani range, where it is circumscribed to Rocca di Novara and Mt. Scuderi (Sciandrello et al. 2015).

Fritillaria messanensis* Raf. subsp. *messanensis: it is an Eastern Mediterranean species, which is restricted to Calabria and Sicily in Italy. Its regional range includes only the Peloritani Mountains, where it is very sporadic, but locally abundant (Picone et al. 2003; Sciandrello et al. 2015).

Helianthemum oelandicum* (L.) Dum. Cours. subsp. *incanum (Willk.) G.Lòpez: this taxon is only report to grow on few calcareous massifs of Western Sicily (Giardina et al. 2007). It is the first report for the eastern part of the island.

***Minuartia recurva* (All.) Schinz & Thell. subsp. *condensata* (C.Presl) Greuter & Burdet**: in Sicily this species is known mainly for the Madonie massif, except for the Rocca di Novara stand, already reported by Giardina (1995).

Odontites bocconei* (Guss.) Walp. subsp. *bocconei (Fig. 3F): this endemism is found mainly in the mountains of North-Western Sicily (Madonie, Sicani, Palermo mountains and Trapani area), while is quite rare in the eastern part, where it is reported only in few localities of Peloritani range, as Pizzo Toscana, Mt. Scuderi, Rocca di Novara, Mt. Kalfa, Mt. Cavallo (Giardina et al. 2007; Sciandrello et al. 2014). In the investigated area it grows only on the calcareous cliffs of the upper part.

***Phelipanche gussoneana* (Lojac.) Domina, Raab-Straube, Rätzel & Uhlich**: this species is spread in the Central and Eastern parts of the Mediterranean area and also in the Crimean Peninsula (Rätzel et al. 2018). In Sicily its distribution is limited to a few locations such as as Rocca Busambra, Madonie massif and is here reported now for the first time in Eastern Sicily.

***Saxifraga callosa* Sm. subsp. *australis* (Moric.) Pignatti ex Tavilla & Del Guacchio** (Figs 3E, 8): The taxon is distributed across the mountains of central-southern Italy, as well as Sicily and Sardinia. In Sicily, it is an extremely rare species linked to mountain cliffs, particularly in select stations within Madonie massif (Giardina et al. 2007). The highly isolated population of Rocca di Novara was firstly discovered by Nicotra (1880) and never reconfirmed until our rediscovery confirming the presence of a small population on the summit cliffs of the mountain (see Tavilla 2024).

Conclusions

This floristic survey allowed to record the presence of 300 angiosperms in Rocca di Novara area. Ferns group counts 10 species, corresponding to 3.3% of the local vascular flora. The most numerous families were Asteraceae and Fabaceae with 12.3% and 10%, respectively, followed by Lamiaceae, Poaceae, Caryophyllaceae, Brassicaceae, Orchidaceae, Apiaceae and Plantaginaceae, with more than 10 species each one. All other families account for 49.7% of the local flora

The life-form spectrum reveals the prevalence of therophytes (39.3%). Among the perennial species, hemicryptophytes (32.7%), geophytes (13%) and camephytes (10.7%) are the most abundant life forms. Their high frequency may be related with the local ecological conditions, characterized by shallow soils, high exposure to sunlight,

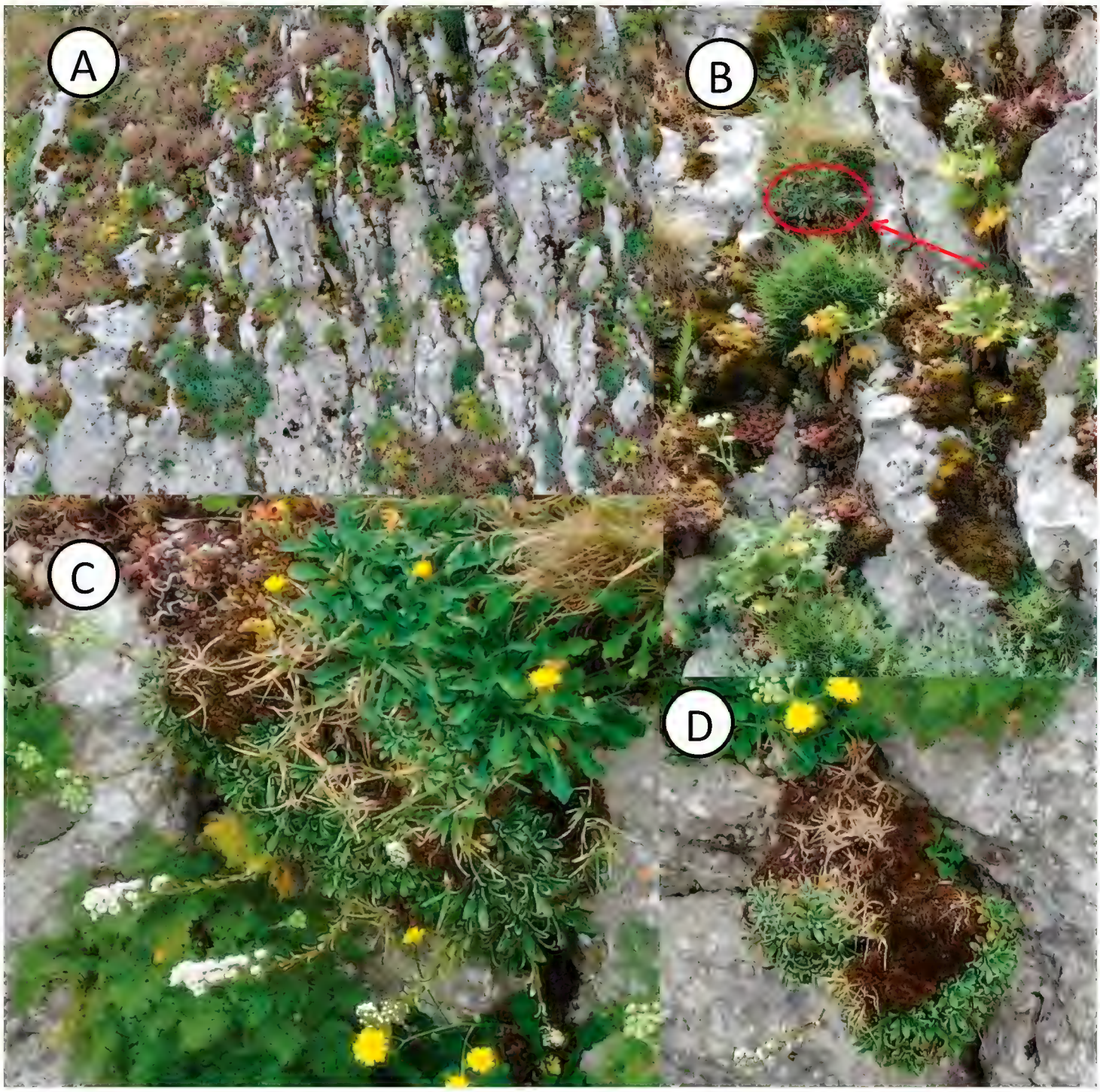

Figure 8. Photos taken with the drone: panoramic view of the cliffs (**A**) specimens of *Saxifraga callosa* subsp. *australis* (**B–D**).

seasonal drought and frequent fires. In particular, the high percentage of chamaephytes is correlated to the presence of several chasmophilous species that colonize the limestone cliffs in the upper part of Rocca di Novara. The low rate of phanerophytes and nanophanerophytes depends on the very scarce forest cover, almost completely eliminated by anthropogenic disturbances.

The occurrence of a high amount of Sicilian and Italian endemics highlights the phytogeographical interest of the local flora, probably issuing from its peculiar geomorphological and climatic characteristics.

Furthermore, the humid and cool microclimate of the top of Rocca di Novara provides conditions suitable to host some interesting disjointed stands of several rare

orophilous plant taxa that in Sicily are known to occur only on the top of the Madonie massif, such as *Saxifraga callosa* subsp. *australis*, *Daphne oleoides* subsp. *oleoides*, *Aubrieta columnae* subsp. *sicula*, *Helianthemum oelandicum* (L.) Dum.Cours. subsp. *incanum* (Willk.) G.Lòpez and *Minuartia recurva* (All.) Schinz & Thell. subsp. *condensata* (C.Presl) Greuter & Burdet (Giardina et al. 2007). In the Peloritani area, only Mt. Scuderi shows such a significant presence of orophilous taxa shared with the Madonie mountain area (Sciandrello et al. 2015).

No alien species were recorded in the investigated area. This is in agreement with Guarino et al. (2021) and Barone et al. (2021), who reported for Sicily that the majority of alien species are concentrated in the coastal areas and in the most disturbed ones while the high mountain areas with little human disturbance have very low percentages of alien taxa.

The comparison of our results with the short list of species of Rocca di Novara reported by Nicotra (1880) prompts some interesting considerations. In particular, this author reported only 50 species for this area, also mentioning *Valeriana tuberosa*, previously reported by Gussone (1843), but not confirmed by him. Of these species, 13 have not beed found in our investigations. Some of them may have been confused with other related taxa and their identification remains doubtful (*Aristolochia longa* L., *Festuca rubra* L. and *F. laevigata* Gaudin), while others (*Sabulina tenuifolia* (L.) Rchb subsp. *tenuifolia*, *Anisantha diandra* (Roth) Tutin ex Tzvelev, *A. tectorum* (L.) Nevski, *Silene conica* L. and *Trigonella elegans* (Salzm. ex Ser.) Coulot & Rabaute) are therophytes widespread in Sicily and their absence could only be temporary or due to sampling biases. The absence of some species with a more pronouncedly orophilous character or linked to mesophilous forest communities (*Pimpinella tragium* Vill., *Echium vulgare* subsp. *pustulatum* (Sm.) Bonnier & Layens, *Katapsuxis silaifolia* (Jacq.) Raf. and *Silene viridiflora* L.) may be attributet to climate changes that has affected the area in past decadesand/or due to anthropogenic disturbancetriggering the reduction of wooded areas. A special mention must be made for *Silene calycina* C.Presl, a poorly known taxon probably related to *Silene bupleuroides* L. Described by Presl (1826), it was reported only for Caltavuturo (isolated mountain of the western Madonie Massif) and was later reported by Nicotra (1880) on the carbonate cliffs of Rocca di Novara. The species has never been found again and is probably extinct, as confirmed also by Sciandrello et al. (2015). Furthermore, two other species cited by Nicotra, *Thymbra capitata* (L.) Cav. and *Gypsophila arrostoi* Guss. subsp. *arrostoi*, are both linked to the lowlands subject to thermo-Mediterranean climate, which were not surveyed in this study.

Finally, this study highlights the importance of preserving the Rocca di Novara Special Area of Conservation (SAC), considering that 12% of the species inventoried are threatened and classified within the IUCN risk categories. A significant issue lies in the in the lack of conservation measures in the face of such a significant plant biodiversity and phytogeographical value of the surveyed habitat., Field investigations have highlighted numerous conservation challenges, mainly related to significant anthropogenic pressure due to intense transhumance grazing, Additionally, climate change

is disrupting ecological niches, pushing plant to adapt to shifting or fading habitats. Temperature variations also generated phenological changes, such as early or delayed blooms. Protecting this ecosystem is essential to safeguard its natural heritage and ensure the survival of native species. Therefore, our results, provide an updated overview of the floristic diversity of Rocca di Novara in the Peloritani mountains and offer fundamental data for further quantitative and qualitative research on vascular plants in the Mediterranean area.

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Supplementary material 1

Inventory of the taxa collected or photographed during the field trip

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Data type: xlsx

Explanation note: Vascular flora of Rocca di Novara, Peloritani, Messina. This table also shows chorotype "Choro" (Alpine-Apenn.= Alpine-Apennine, CentralEurop.= CentralEurope, CentralMedit.= Central Mediterranean, Circumbor.= Circumboreal, Cosmop.= Cosmopolitan, Endem. Ital.= Endemic to Italy, Endem. Sic.= Endemic to Sicily, Eurasian= Eurasian, Euri-Medit.= EuriMediterranean, NE-Eurimedit.= Northeastern-EuriMediterranean, N-Eurimedit.= Northern-EuriMediterranean, Europ.= Europeans, Europ.-Caucas.= European-Caucasian, Eurosib.= Siberian European, Medit.= Mediterranean, Medit.-Atl.(Euri-)= Mediterranean-Atlantic (Euri-), CE-Medit.= Central Eastern Mediterranean, Medit.-Mount.= Mediterranean-mountainous, Medit.-Turan.= Mediterranean-Touranian, N-Medit.= Northern Mediterranean, NE-Medit.= Northeastern Mediterranean, NW-Medit.= Southwestern Mediterranean, Orop. S-Europ.= Orophyte Southern European, Orop. S-Medit.= Orophyte Southern Mediterranean, Orop. SE-Europ.= Orophyte South East Europe, Orop. SW-Europ.= Orophyte South West Europe, Paleosubtrop.= Paleosubtropical, Paleotemp.= Paleotemperate, S-Europ.= South Europe, S-Medit.= South Mediterranean, SE-Europ.= South East Europe, Steno-Medit.= Steno-Mediterranean, NE-Stenomedit= Northeastern-StenoMediterranean, SW-Stenomedit.= Southwestern Steno-Mediterranean, W-Stenomedit.= Western Steno-Mediterranean, Subcosmopol.= Subcosmopolitan, Subendem.= Subendemic, Submedit.= Submediterranean, Subtrop.= Subtropical, SW-Medit.= Southwestern Mediterranean, W-Europ.= Western Europe, W-Medit.= Western Mediterranean). Life form "LF" (T= therophytes, Ch= chamaephytes, P= phanerophytes, NP= nanophanerophytes, H= hemicryptophytes, G= geophyte). "Red List" were found to be in IUCN risk categories (EN= endangered, VU= vulnerable, NT= near threatened, LC= least concern).

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